

REMARKS

Claims 16-34 are all the claims presently pending in the application. Claims 1-4 and 7-15 have been canceled without prejudice or disclaimer. New claims 24-34 have been added to more particularly define the invention. Claims 16-23 stand rejected upon informalities under 35 U.S.C. § 112, second paragraph. Reconsideration is respectfully requested.

With respect to the prior art rejections, Claims 16 and 21-22 stand rejected under 35 U.S.C. § 102(b) as anticipated by Kitahara (U.S. Patent No. 5,646,662). Claims 16 and 21-22 stand rejected under 35 U.S.C. § 102(e) as anticipated by Chong (U.S. Patent No. 6,093,330). Claims 16-21 and 23 stand rejected under 35 U.S.C. § 102(e) as anticipated by Farnaam (U.S. Patent No. 6,036,874).

These rejections are respectfully traversed in view of the following discussion.

It is noted that the amendments are made only to more particularly define the invention and not for distinguishing the invention over the prior art, for narrowing the scope of the claims, or for any reason related to a statutory requirement for patentability.

It is further noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

I. THE CLAIMED INVENTION

Applicant's invention, as disclosed and claimed, for example by claim 16 is directed to a method for manufacturing an ink jet recording head.

The method includes forming a pressure generating chamber from a chamber plate with a pair of sides such that the pair of sides include a plurality of arcuate portions. (See Page 11, lines 2-8; Page 22, line 23-Page 23, line 8; Page 24, line 25-Page 25, line 6; Page 35, lines 2-20; and Figures 3-7).

Conventional methods include forming an ink jet recording head where the pressure generating chamber includes "a through-hole [is so] formed to be straight in a direction perpendicular to the major surfaces of the conventional chamber plate," i.e., an "inner edge surface extend[s] in a direction perpendicular to an upper or major surface of the chamber plate" thus forming a substantially rectangular shape with substantially square corner portions. However, the ink flow path is "bent at substantially right angles on the midway to reach the ink ejection nozzle." Thus, this structure causes "stagnation in the ink flow, formation of vapor bubbles, cavitation (which is caused by a large and sudden change in cross-sectional area of the ink flow passage), or like problems occur at corner portions of the pressure generating chamber and also in the vicinities of these corner portions." (See Page 4, lines 19-29; Page 5, lines 1 - Page 6, line 7; Page 33, lines 6-29; and Figure 8).

An aspect of the inventive method includes the pair of sides include a plurality of a plurality of arcuate portions, which provides for "the pressure generating chamber to obtain a relatively smooth inner wall surface therein by forming a first and a second hole portion, wherein the first and second hole portions communicate with each other to form the pressure generating chamber." (See Page 7, line 28 - Page 8, line 6; Page 23, lines 13-23; Page 32,

lines 1-29; Page 34, lines 12-29; and Figures 4 and 6).

As a result of this inventive method, the ink jet recording head is “free from any problems such as stagnation in the ink flow, formation of vapor, bubbles, cavitation, or like problems occurring in the ink flow in the pressure generating chamber.” Thus, this invention ensures excellent ink ejection operation, a high quality gradation expression in recording operations, and “remarkably lessens an alignment accuracy required in a stacking or assembly operation of its plates or components.” (See Page 8, lines 7-22).

II. 35 U.S.C. § 112, Second Paragraph, Rejection regarding Claims 16-23

Applicant has amended and renumbered the claims in a manner believed fully responsive to all points raised by the Examiner. Regarding claim 21, please note, the plurality of ink outlet passages each communicate with a portion of the pressure generating chamber.

In view of the foregoing, the Examiner is respectfully requested to withdraw these rejections.

III. THE PRIOR ART REJECTIONS

A. The Kitahara Reference

Kitahara (“Kitahara”) fails to teach or suggest the features of independent claim 16, including the pair of sides include a plurality of arcuate portions. (See Page 11, lines 2-8; Page 22, line 23-Page 23, line 8; Page 24, line 25-Page 25, line 6; Page 35, lines 2-20; and Figures 3-7).

Instead, Figures 2 and 7 of Kitahara only teach a conventional recording head of an ink-jet type including an ink pressure chamber 7 contacting a nozzle plate 1, where the nozzle

plate includes a concave portion 3 situated between and connecting the ink pressure chamber and a nozzle 2. Applicant respectfully submits that the Office Action mischaracterizes Kitahara because Kitahara only teaches that the ink pressure chamber 7 has a substantially rectangular shape. In particular, the ink pressure chamber 7 similar to the conventional art appears to include the concave portion 3 and related nozzle 2 formed perpendicular to the major surfaces of the ink pressure chamber 7, which includes a substantially rectangular shape with substantially straight sides and substantially square corner portions. Accordingly, the ink flow path from the ink supply passage 10 through the ink pressure chamber 7 is “bent at substantially right angles on the midway to reach the ink ejection nozzle.” Thus, this structure may likely causes “stagnation in the ink flow, formation of vapor bubbles, or like problems occur at corner portions of the pressure generating chamber and also in the vicinities of these corner portions.” (See Kitahara at Abstract; Column 2, line 45-Column 3, line 14; and Figures 2, 3 and 7).

Please note, the concave portion 3 is formed in the nozzle plate 1 not the ink pressure chamber 7.

In contrast, Applicant’s invention teaches forming a pressure generating chamber 19 from a chamber plate 16 with a pair of sides such that the pair of sides include a plurality of arcuate portions of a first hole portion and a second hole portion 19a, 19b. In particular, the plurality of arcuate portions include relatively smooth inner wall surfaces where the first hole portion, i.e., an upper hole portion, is displaced sidewardly in a direction parallel to the flow direction of the ink by an amount relative to the second hole portion, i.e., a lower hole portion.

Indeed, Kitahara only teaches that the ink pressure chamber 7 is a substantially

rectangular shape with substantially straight sides and substantially square corner portions, whereas Applicant teaches that the pressure generating chamber 19 includes a pair of sides such that the pair of sides include a plurality of arcuate portions not substantially straight sides.

Consequently, the Kitahara structure may likely provide “stagnation in the ink flow, formation of vapor bubbles, cavitation (which is caused by a large and sudden change in cross-sectional area of the ink flow passage), or like problems occur at corner portions of the pressure generating chamber and also in the vicinities of these corner portions.” (See Page 4, lines 19-29; Page 5, lines 1 - Page 6, line 7; Page 33, lines 6-29; and Figure 8). Accordingly, Kitahara only discloses a conventional recording head of an ink-jet type with a substantially rectangular ink pressure chamber focused on “a configuration of nozzles of the recording head” with “a nozzle plate capable of accurately emitting ink droplets without deforming the nozzle plate when pressure is applied for emitting the ink droplets.” (See Kitahara at Abstract; Column 1, lines 5-12 and lines 50-63).

Since Kitahara does not teach, suggest or disclose including that the pair of sides include a plurality of arcuate portions as cited in claim 16 of Applicant’s invention, Kitahara is deficient and thus does not teach the specific limitations of dependent claims 21 and 22.

For the reasons stated above, the claim invention, and the invention as cited independent claim 16, and related dependent claims 21 and 22, are fully patentable over the cited reference.

B. The Chong, et al. Reference

Chong, et al. (“Chong”) fails to teach or suggest the features of independent claim 16, including the pair of sides include a plurality of arcuate portions. (See Page 11, lines 2-8; Page 22, line 23-Page 23, line 8; Page 24, line 25-Page 25, line 6; Page 35, lines 2-20; and Figures 3-7).

Instead, Figures 37-40 of Chong only teach a microfabrication process for enclosed microstructures where the related microstructure includes a substrate 302 with an ink reservoir 300 connected to an outlet orifice 306 through a sub-surface tunnel 304. Contrary to the assertion in the Office Action, the sub-surface tunnel 304 is structurally and functionally equivalent to a tunnel not a pressure generating chamber as suggested in the Office Action. In particular, two parallel overhanging bars 312 and 314 overhang an enlarged cavity 316 of the sub-surface tunnel 304 where current flows through the overhanging bars 312 and 314 so the bars act as a resistive heater for fluid in the enlarged cavity, i.e., chamber 316. “By controlling the current flow through these bars, fluid in the chamber 316 may be heated and ejected out of the orifice 306 to provide an ink jet or similar fluid pump.”

Thus, the heating of the ink causes the ink to flow from the ink reservoir 300 through the sub-surface tunnel 304, and nowhere does Chong teach or disclose that a physical pressure is applied to the ink or the sub-surface tunnel 304 to cause the flow of ink. Accordingly, the sub-surface tunnel is simply a heated -sub-surface tunnel not a pressure generating chamber. (See Office Action, Page 5, lines 5-8; Chong at Abstract; Column 17, line 59-Column 18, line 26; and Figures 37-40).

In contrast, as discussed above, Applicant’s invention teaches forming a pressure generating chamber 19 from a chamber plate 16 with a pair of sides such that the pair of sides

include a plurality of arcuate portions of a first hole portion and a second hole portion 19a,
19b.

Indeed, Chong only teaches that the microstructure includes a sub-surface tunnel 304 where ink is heated not a pressure generating chamber 19, let alone, a pressure generating chamber includes a pair of sides such that the pair of sides include a plurality of arcuate portions as cited in Applicant's claimed invention.

Consequently, the Chong structure may likely provide "stagnation in the ink flow, formation of vapor bubbles, or cavitation (which is caused by a large and sudden change in cross-sectional area of the ink flow passage)." (See Page 4, lines 19-29; Page 5, lines 1 - Page 6, line 7; Page 33, lines 6-29; and Figure 8). Accordingly, Chong is only focused on a method of fabricating micro-structures, which uses various deposition and etching techniques as oppose to conventional mechanical micro-machining to form various micro-structures, including the related micro-structure with a sub-surface tunnel as discussed above. (See Chong at Abstract; Column 1, lines 5-10; and Column 3, lines 33 - Column 4, line 13).

Since Chong does not teach, suggest or disclose including a pressure generating chamber, let alone, forming a pressure generating chamber from a chamber plate with a pair of sides such that the pair of sides include a plurality of arcuate portions as cited in claim 16 of Applicant's invention, Chong is deficient and thus does not teach the specific limitations of dependent claims 21 and 22.

For the reasons stated above, the claim invention, and the invention as cited independent claim 16, and related dependent claims 21 and 22, are fully patentable over the cited reference.

C. The Farnaam. Reference

Farnaam (“Farnaam”) fails to teach or suggest the features of independent claim 16, including the pair of sides include a plurality of arcuate portions. (See Page 11, lines 2-8; Page 22, line 23-Page 23, line 8; Page 24, line 25-Page 25, line 6; Page 35, lines 2-20; and Figures 3-7).

Instead, Figure 5D of Farnaam only teaches a method for fabricating nozzles for ink jets where the related nozzle includes an aperture 533 and a chamber 531 formed in a layer of nozzle material 518. Contrary to the assertion in the Office Action, the chamber 531 is structurally and functionally equivalent to an ink outlet passage formed in a nozzle material not a pressure generating chamber formed in a chamber plate as suggested in the Office Action. In particular, as indicated, the chamber 531 is formed in a layer of nozzle material that results in the formation of a hemispherical chamber with a reasonably thick wall 532 surrounding the aperture 533. “This may provide superior strength and wear characteristics compared to a similar aperture formed by planarizing the nozzle material to expose the mold material.” Accordingly, this structure relates solely to forming an ink nozzle, including the chamber, as the chamber 531 and aperture are formed from nozzle material not chamber plate material.

Thus, the chamber 531 has a “reasonably thick wall,” which is not disclosed as being compressible, i.e., a physical characteristic of a pressure generating chamber. Based on this structure, the ink simply flows through the chamber 531 and out of the aperture 533 as part of the nozzle structure not subject to pressure in a pressure generating chamber where the chamber is compressed prior to the ink flowing out of the nozzle structure. (See Office Action, Page 6; Farnaam at Abstract; Column 8, line 33-Column 9, line 20; and Figure 5D).

In contrast, as discussed above, Applicant's invention teaches forming a pressure generating chamber 19 from a chamber plate 16 with a pair of sides such that the pair of sides include a plurality of arcuate portions of a first hole portion and a second hole portion 19a,

19b. The pressure chamber is connected to an ink outlet passage 33 formed in an ink supply plate 30.

Indeed, Farnaam only teaches that the nozzle includes a chamber 531, which is structurally and functionally equivalent to Applicant's ink outlet passage, not a pressure generating chamber 19, let alone, a pressure generating chamber includes a pair of sides such that the pair of sides include a plurality of arcuate portions as cited in Applicant's claimed invention.

Accordingly, Farnaam is only focused on a method of fabricating nozzles for ink-jet printers (See Farnaam at Abstract; Column 1, lines 5-10; Column 2, lines 28-40).

Since Farnaam does not teach, suggest or disclose including a pressure generating chamber, let alone, forming a pressure generating chamber from a chamber plate with a pair of sides such that the pair of sides include a plurality of arcuate portions as cited in claim 16 of Applicant's invention, Farnaam is deficient and thus does not teach the specific limitations of dependent claims 17-21 and 23.

For the reasons stated above, the claim invention, and the invention as cited independent claim 16, and related dependent claims 17-21 and 23, are fully patentable over the cited reference.

IV. FORMAL MATTERS AND CONCLUSION

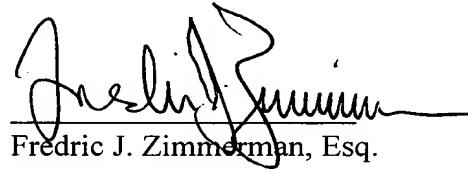
In view of the foregoing, Applicant submits that claims 16-34, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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